Chapter 3

How the Risk Assessment Was Done

This chapter looks at the methods and assumptions behind the tritium risk assessment. Please see chapter 4 for more detailed information, equations that show how the risk assessment was carried out, summaries of the data used in the analysis, and a description of the **models** and methods used to quantify both risks and uncertainties.

3.1 General Approach

In each of the three defined zones risk levels for three effects (fatal cancers, heritable genetic effects, and reproductive and developmental effects) were estimated on the basis of a continuous tritium release of 100 curies per year. To find the risk levels associated with larger or smaller releases, multiply this report's risk levels by the ratio of the larger or smaller release (in curies) to the assumed 100 curie release for the year of assessment. Health impacts of accidental releases are beyond the scope of this report.

3.2 Computer Modeling Used in the Risk Assessment

The risk assessment used computer models to simulate tritium releases from the NTLF for both current and past levels. These models simulate the system and process that account for the known or inferred properties of tritium exposure and health risk. The primary goal of the models was to determine how tritium could spread out from the point of release, and, specifically, how tritium will:

- Remain or spread within the envelope of air to which it is released.
- Be **transported** to other parts of the environment by natural events such as wind dispersion, evaporation, precipitation.
- Be physically transformed by radioactive decay.

There are two risk assessment calculations provided in this report. In the main body of the text we provide a risk assessment based on a mass-balance box model, and in Appendix E we provide the results of a risk assessment carried out using the U.S. EPA CAP88 model. These two assessments came up with very similar results in Zone 2. In Zone 1 the EPA model predicts lower risks and was not used in this Zone. The estimates of risk in Zone 3 are based primarily on the concentrations from the CAP88 model in Appendix E combined with the uptake dose model developed for Zone 2.

The models characterize the contamination of air, surface water, soils, and plants adjacent to the NTLF. Estimates of corresponding doses and risks to human populations are based on these contamination levels. The models were validated by comparing model predictions of tritium levels in air, water and soil with corresponding field data obtained in 1995.

The model used to characterize the spread of tritium includes two major components—air and soil. Water and vegetation as exposure media are assumed to be in equilibrium with air and/or soil. This "two-compartment" structure was applied in two of the exposure zones (zones 1 and 2). The air compartment is represented by a box that receives the NTLF air emissions as well as emissions from soil and vegetation that have retained tritium from previous emissions. Losses from air include deposition to soil, wind-driven convective losses, and radioactive decay. The soil compartment represents the surface layer of soil that receives tritium as deposition from air. Losses from soil include diffusion to air, diffusion and infiltration to deeper soil layers, runoff to surface water, and radioactive decay. Landscape, climate and hydrology parameters used in the analysis are derived from site-specific information. Figure 3-1 illustrates the compartment model.

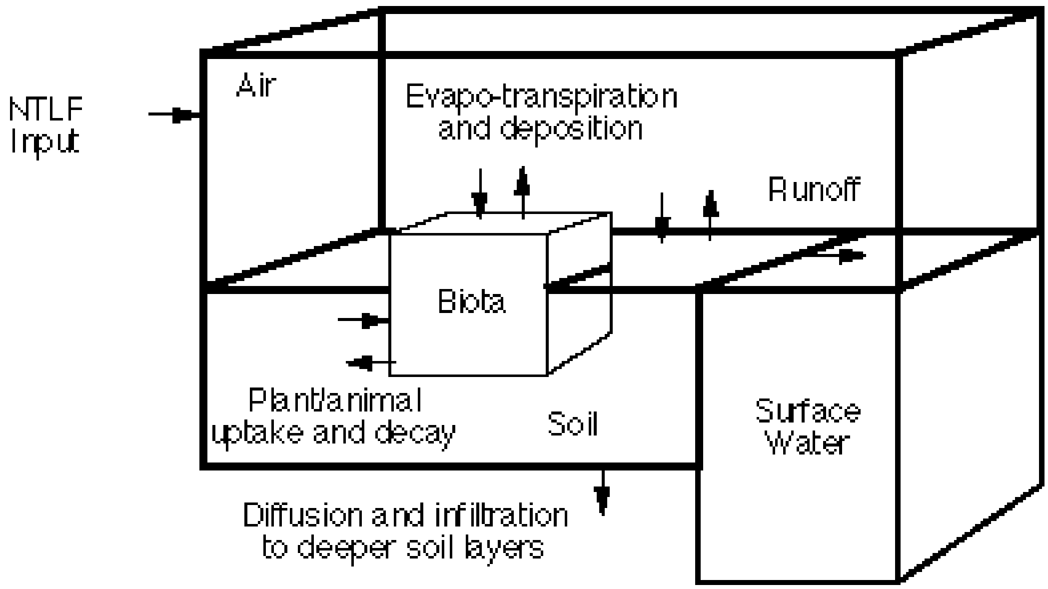

Figure 3-1. The two-compartment model.

To determine ranges of human exposure and the doses for adults, infants, and fetuses in the exposed populations, the concentrations of tritium in environmental media (air, food and surface water) were combined with the rates at which people come in contact with these media through inhalation, ingestion, and absorption. These doses were combined with risk factors for cancer mortality, genetic defects, and reproductive and developmental effects to estimate population and individual risks for the three zones. Figure 3-2 illustrates the process of tritium dispersion used to assess risks.

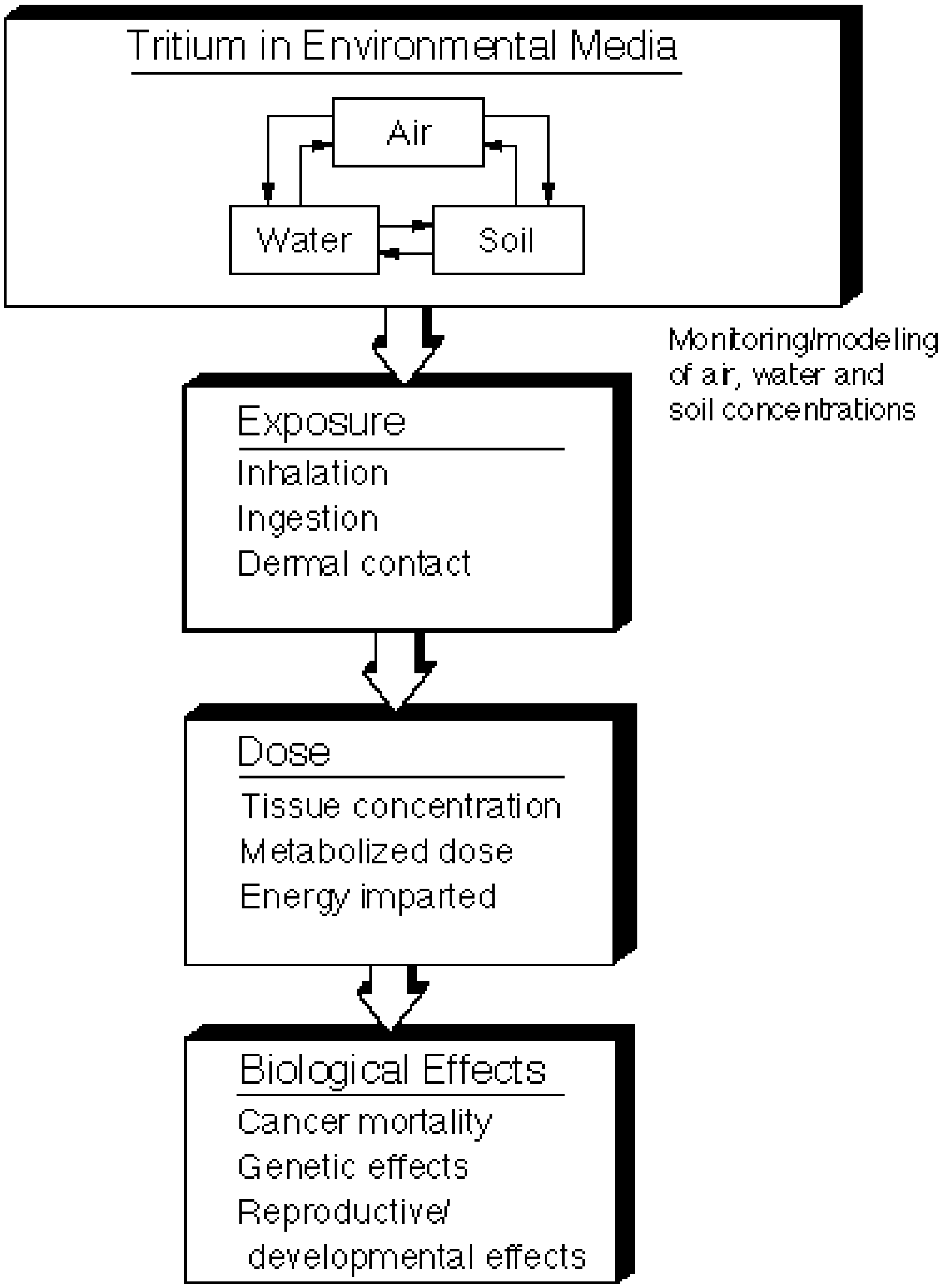

Figure 3-2. Risk assessment framework.

3.3 Accidents

As is noted previously, accidental releases are beyond the scope of this report. However, this statement refers to large and catastrophic accidents. Monitored stack emissions, which are used to define the source term for the risk assessment, include both routine (normal) releases and small accident (off-normal) events, and thus small accidents are implicitly included in the risk assessment. Even though this risk assessment does not explicitly deal with accidental releases, health impacts from such accidents can be estimated by using information in the risk assessment. Risk levels associated with releases larger than 100 Ci/y can be found by multiplying this report's risk levels by the ratio of the larger release rate (averaged over the same time period) to the 100 Ci/y release rate. For example, one accidental release of 5,000 Ci over a 70-year period would effectively increase the estimated risk associated with the continuous release of 100 Ci/y by a factor of 1.7.